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A THREE DIMENSIONAL MODEL OF THE VENUSIAN THERMOSPHERE WITH SUPERROTATION

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An improved three-dimensional spectral model of the thermosphere of Venus is described. The model solves the Navier-Stokes equations and includes nonlinear effects for an arbitrary number of atmospheric species. A two-dimensional axisymmetric model of the superrotation of the thermosphere is also presented. This model addresses the Pioneer-Venus mission finding, which suggested the thermospheric rotation rate to be much higher than that of the planet as seen from the asymmetric distribution of hydrogen and helium. Both models include the effects of an anisotropic eddy diffusion that is consistent with atmospheric mixing length theory.

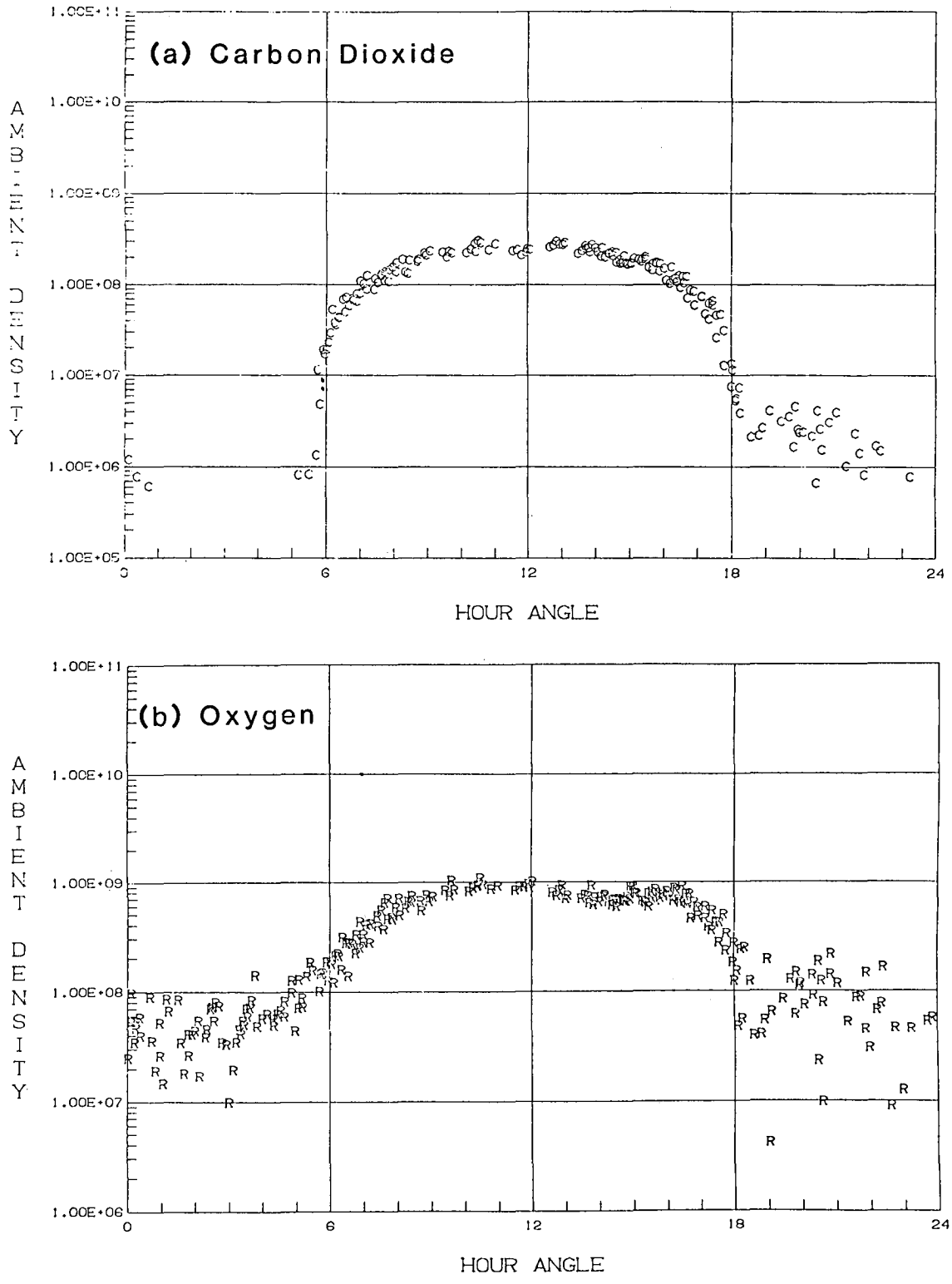

Figure 1. Pioneer Venus density profiles for carbon dioxide and oxygen (W. T. Kasprzak and A. E. Hedin, private communication).

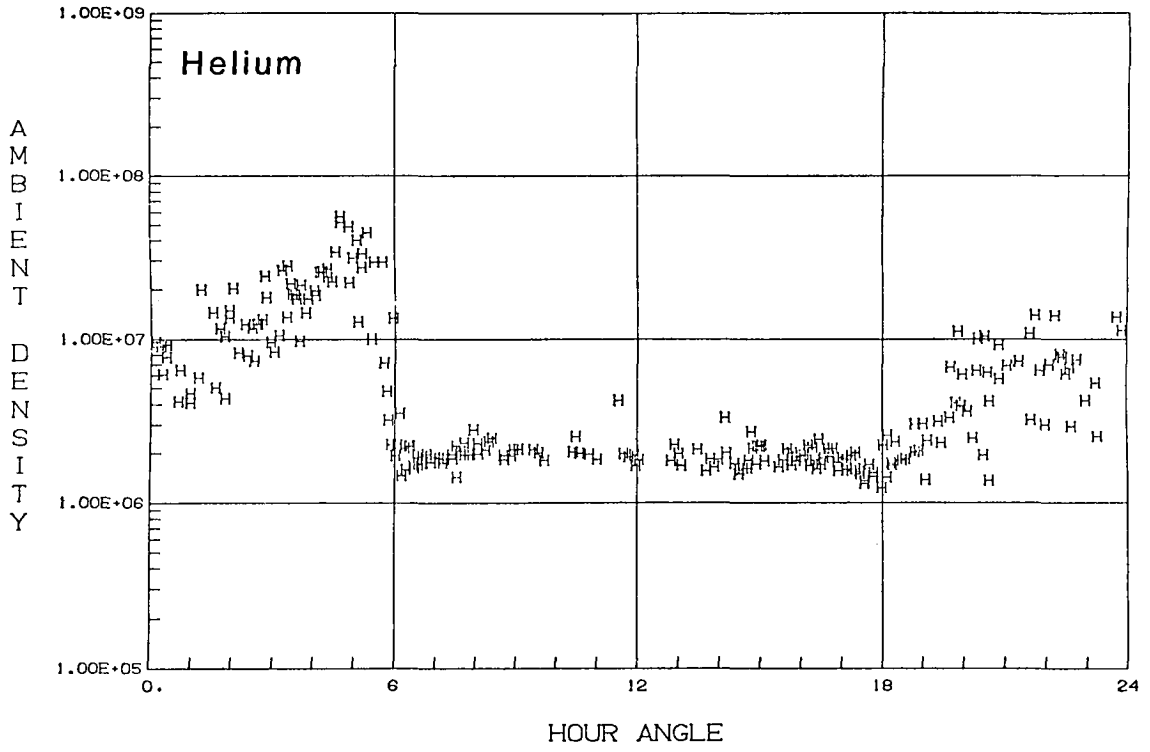

Figure 2. Pioneer Venus density profile for helium (ibid.).

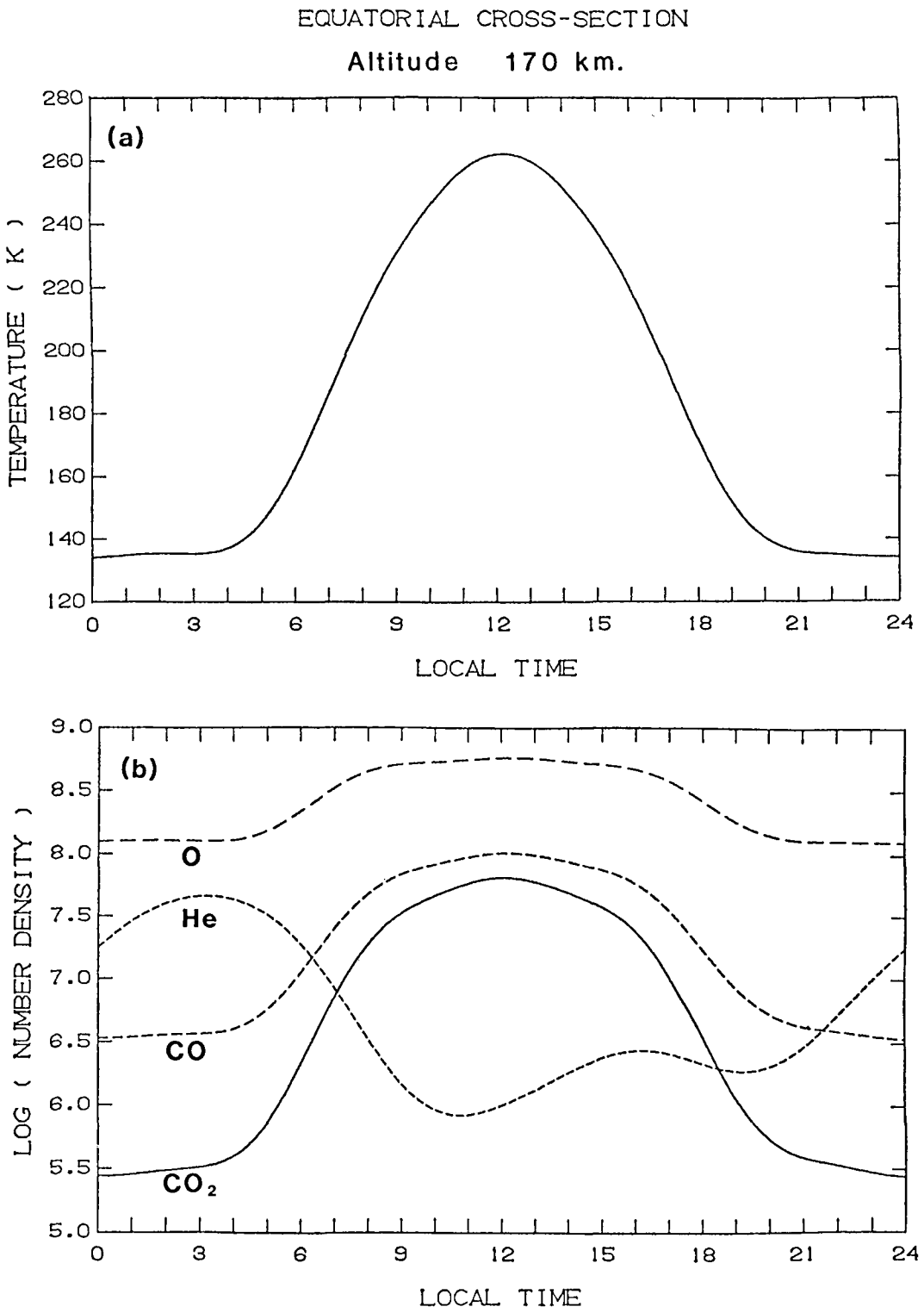

Figure 3. Thermospheric dynamics model results:
(a) Equatorial cross-section of temperature versus local time at 170 km.
(b) Equatorial cross-section of densities versus local time at 170 km.

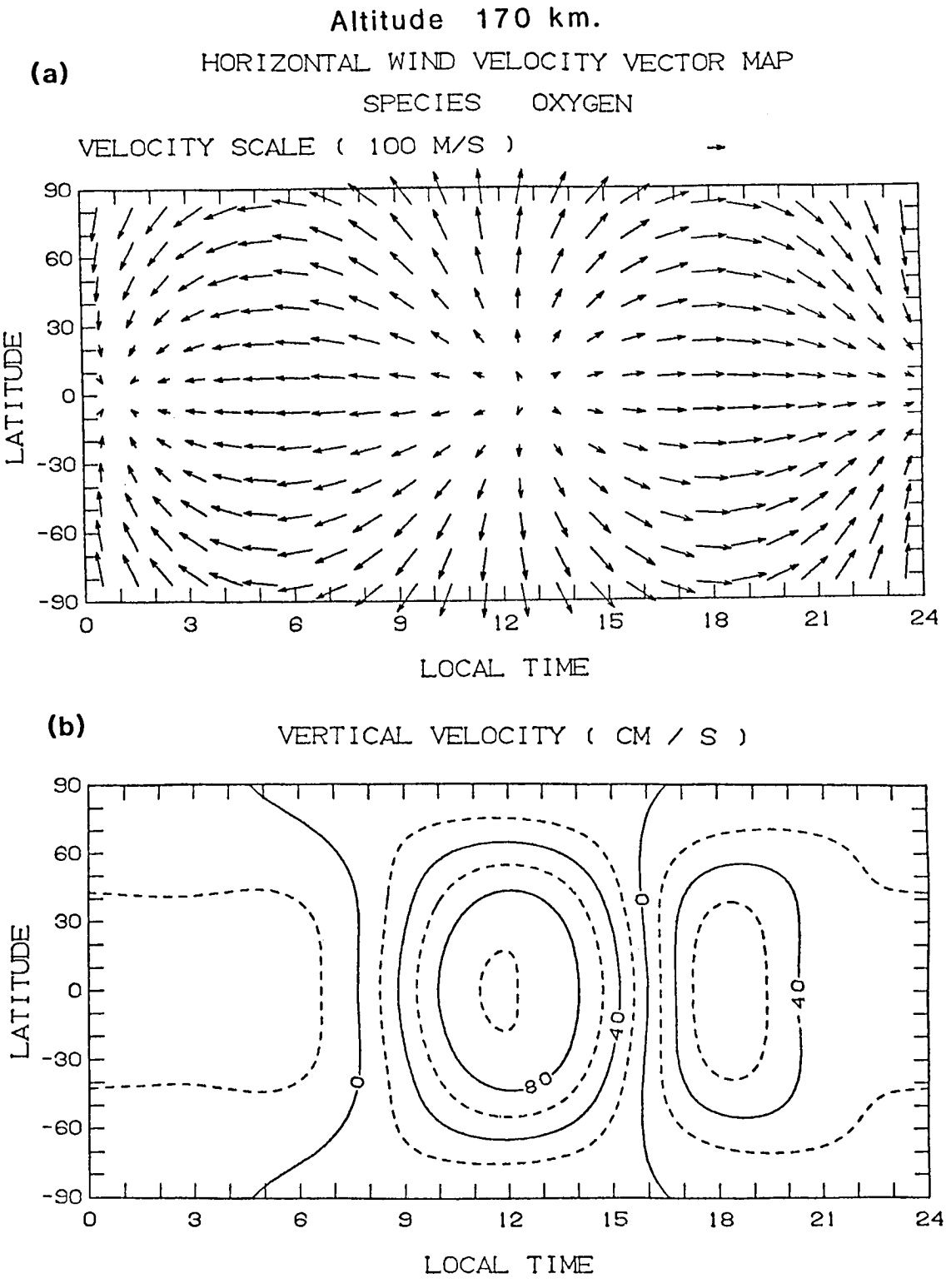

Figure 4. Thermospheric dynamics model results:
(a) Horizontal wind velocity vector map at 170 km.
(b) Contour map of vertical velocity for oxygen at 170 km.

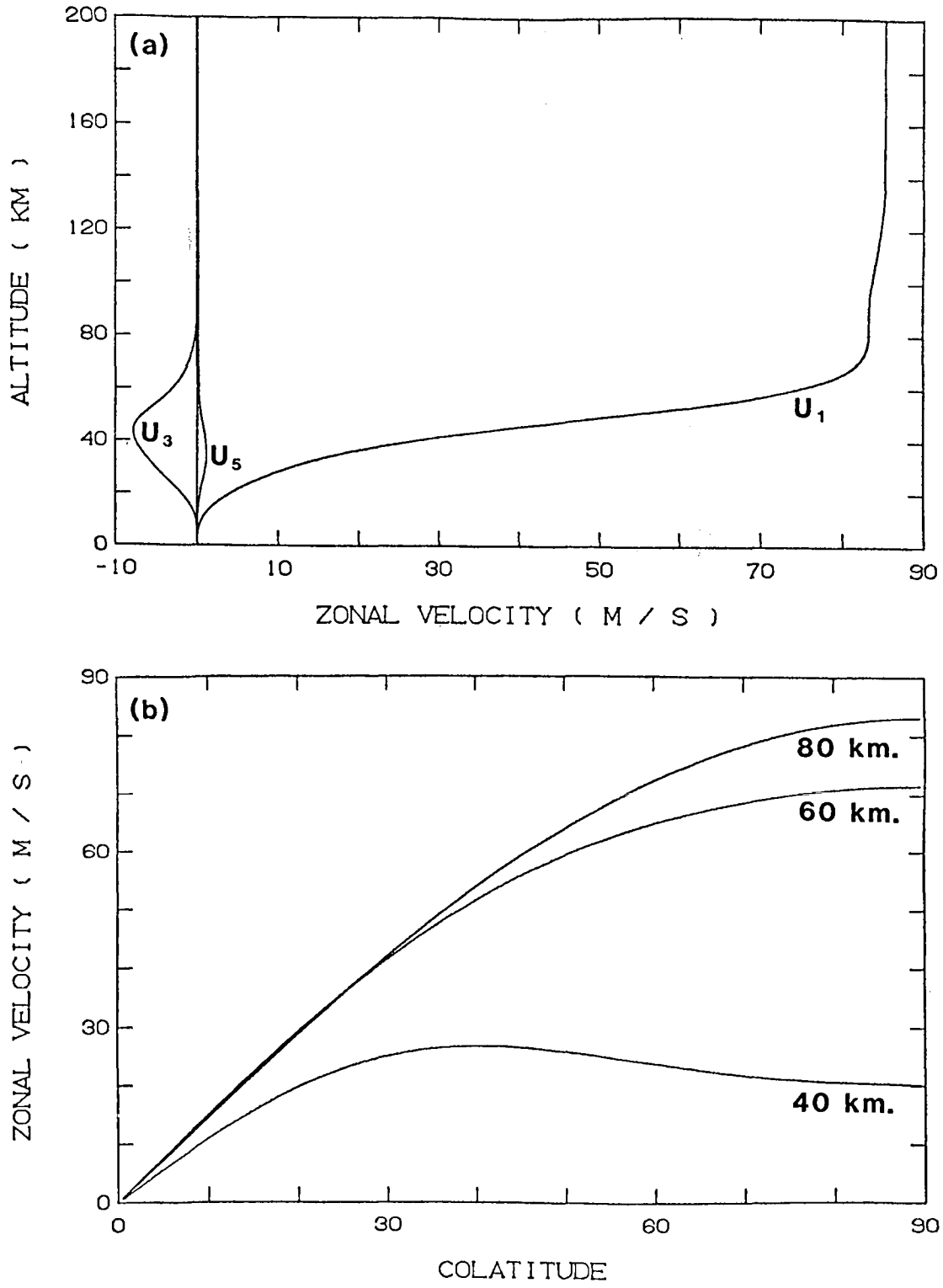

Figure 5. Superrotation model results:
(a) Zonal velocity components versus altitude.
(b) Zonal velocity versus latitude.